



LDAR Audit Final Report

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SECTION 1

INTRODUCTION

Sage ATC Environmental Consulting, LP (Sage) has completed an audit of the Leak Detection and Repair (LDAR) program at the Merit Energy (Merit) facility located in Kalkaska, Michigan. This audit was conducted in compliance with the requirements for an Enhanced LDAR Program (ELP) as specified by Merit's Consent Decree (CD) with the U.S. Environmental Protection Agency (EPA). The Sage audit team consisted of Chen Zhu, David Ranum, and Tarun Johnson. Merit's LDAR data base was reviewed off-site by Chen Zhu. The on-site portion of the audit was conducted by David Ranum and Tarun Johnson between June 20 to June 24, 2016.

This report has four sections:

-) Section 1: An Introduction;
-) Section 2: Audit Scope;
-) Section 3: Audit Methodology; *and*
-) Section 4: Audit Results.

A Glossary of Abbreviations is provided at the end of this report.

Table 1-1 defines the Consent Decree audit requirements for the Covered Process Units together with a summary of the audit results for each requirement. A detailed discussion of the audit outcome is provided in Section 4. Based upon the results of this audit, Sage found the LDAR program at the Merit facility to be in compliance with applicable federal, state, and Consent Decree LDAR requirements in effect at the time of the audit.

Table 1-1
Audit Requirements and Results

CD CITATION PARAGRAPH	AUDIT REQUIREMENT	AUDIT RESULTS (<i>Compliance Issues Listed in Italics</i>)
43(i)	Review compliance with all applicable LDAR regulations and the CD's Enhanced LDAR Program (ELP) including LDAR requirements related to valves and pumps in heavy liquid service.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> ✓ A field verification of randomly selected Difficult to Monitor (DTM) valves indicated that all were properly classified as DTM. ✓ Component tagging was found to be in good order. ✓ LDAR database rules were reviewed for accuracy and no issues were noted. ✓ A records review as well as a discussion with the LDAR Coordinator, indicated compliance with the CD's ELP low-emission (Low-E) valve replacement requirements. ✓ No Open Ended Lines (OELs) were discovered during the comparative monitoring.
40a [43(ii)]	Verify appropriate monitoring frequencies.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> ✓ A database review of monitoring records from 2nd Quarter 2015 through 1st Quarter 2016 indicated that all applicable components had been monitored at the required frequency.
40b [43(ii)]	Verify that proper documentation and sign offs have been recorded for all equipment placed on the Delay of Repair (DOR) list.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> ✓ The auditors checked for proper DOR documentation and sign offs and visually inspected each DOR component to verify that it could not be isolated for repair.
40c [43(ii)]	Ensure that repairs have been performed in the required periods.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> ✓ Database records from 2nd Quarter 2015 through 1st Quarter 2016 were reviewed for compliance with first and final repair deadlines. All required first repair attempts were performed on schedule. All leaking components were either repaired or placed on DOR within 15 days.
40d [43(ii)]	Review monitoring data and equipment counts for feasibility (e.g., number of pieces of equipment monitored per day) and unusual trends.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> ✓ Component monitoring counts were calculated and monitoring data was reviewed for abnormalities. Monitoring pace was judged to be reasonable. No instances of overly fast monitoring were noted during the data review period. ✓ No monitoring abnormalities were identified.

CD CITATION PARAGRAPH	AUDIT REQUIREMENT	AUDIT RESULTS (<i>Compliance Issues Listed in Italics</i>)
40e [43(ii)]	Verify that proper calibration records and monitoring instrument maintenance information are maintained.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> J Calibration records from July 2015 to May 2016 were reviewed and instrument calibration by the one (1) available monitoring technician was observed. No compliance issues were noted. J Calibration gas certification records were reviewed for compliance with expiration dates and accuracy requirements. No issues were noted. J A record of instrument maintenance was provided upon request. J A recommendation was made to purchase a calibration span gas approximately equal to 250 ppm.
40f [43(ii)]	Verify that other LDAR program records are maintained as required.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> J There were no Unsafe to Monitor (UTM) components during the audit. Compliance with DTM justification was reviewed. No compliance issues were noted. J The facility's Management of Change (MOC), Quality Control (QC) and Chronic Leaker programs were reviewed. No systemic issues were noted. J Records showing compliance with annual monitoring technician training requirements were provided upon request. J Several recommendations were offered concerning the LDAR Plan.
40g [43(ii)]	Observe in the field each LDAR monitoring technician who is conducting leak detection monitoring to ensure that monitoring is being conducted as required.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> J The one available monitoring technician was observed as he performed Method 21 monitoring of several valves and a pump. Monitoring pace and coverage were judged to be appropriate.
43(iii)	Review whether any pieces of equipment that are required to be in the LDAR program are not included.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> J A database review, field inspections, a "ghost tag" review and an examination of marked up Process and Instrumentation Drawings (P&IDs) found no LDAR inventory issues.
43(iv)	Perform Comparative Monitoring of Different Component Types in Covered Units and Calculate Leak Percentages and the Comparative Monitoring Leak Ratio for each.	<p><u>No Compliance Findings:</u></p> <ul style="list-style-type: none"> J Comparative monitoring was conducted on valves and pumps in all of the units covered by the ELP. The results verify the facility's historical leak rate. Leak Rate Ratios were < 3.0.

SECTION 2

AUDIT SCOPE

The LDAR Audit at the Merit Kalkaska, Michigan facility covered the following areas:

-) Comparative Monitoring;
-) Compliance with LDAR monitoring and repair requirements;
-) LDAR recordkeeping requirements;
-) LDAR component applicability;
-) LDAR component inventory accuracy;
-) The LDAR plan;
-) Monitoring technician annual training;
-) LDAR Contractor QA/QC procedures;
-) OEL and sample station flushing control;
-) DTM and DOR justification;
-) Compressor LDAR status;
-) Observation of the LDAR technician performing analyzer calibration and Method 21 monitoring; *and*
-) LDAR MOC, QA/QC, and Chronic Leaker programs review.

2.1 Field Activities

Comparative Monitoring – Comparative monitoring of valves and pumps in gas/vapor and light liquid LDAR service was performed in all covered units. The number of components monitored by the auditors in each unit is provided in Table 2-1.

Table 2-1
Number of Components Monitored by Component Type

Covered Unit	# Valves Monitored	Valve Population	% Valves Monitored	# Pumps Monitored	Pump Population	% Pumps Monitored
Cryo	128	334	38%	3	3	100%
Flare	83	89	94%	0	0	--
Gas Dehydration	135	263	51%	0	0	--
Inlet Gas	56	56	100%	0	0	--
PreBoost	59	117	50%	0	0	--
Refrigerant	138	384	36%	0	0	--
Stabilizer	192	594	32%	3	3	100%
Storage Tanks	351	1520	23%	11	11	100%
Units Total	1142	3355	34%	17	17	100%

Tagging, OELs & Sample Stations -- While conducting comparative monitoring in the units, the auditors also evaluated tagging accuracy, open-ended line control, and sample station flushing

control. Tagging accuracy was checked by noting any untagged components on potentially regulated lines and asking the site to verify that these components were either in the database or did not need to be. Open-ended line control was evaluated by noting any instances of 1) unplugged or uncapped hydrocarbon lines without double-block control, 2) double-blocked lines with one or both of the blocking valves open, or 3) unsecured or loose blind flanges. Sample stations were checked for proper flushing control by verifying that the flushing fluid, if a liquid was either returned to the process, routed to a control device, or captured in a sealed container for disposal.

Calibration & Monitoring Observation -- Instrument calibration procedures were evaluated by observing one technician calibrate the analyzer at the start of the day. Technician monitoring was evaluated for proper coverage and pace by observing the same technician as he monitored selected valves and pumps.

Interviews -- An interview with the LDAR Coordinator was conducted on the subjects of LDAR Management of Change (MOC), LDAR Quality Assurance/Quality Control (QA/QC), and compliance with the Consent Decree's Low Leak Technology requirements. The LDAR technician was also interviewed separately on Method 21 monitoring and analyzer calibration procedures. A review of LDAR compressor requirements was covered with the LDAR Coordinator.

2.2 Recordkeeping Review

Using independent queries, a recordkeeping review was performed of the LDAR database (Guideware) from 2nd Quarter 2015 through 1st Quarter 2016. This review included:

-) First Attempts at Repair and Final Repair Within the Required Timeframe;
-) DTM Valve Monitoring Completion;
-) Normal to Monitor (NTM) Valve Monitoring Completion;
-) Pump Monthly Monitoring Completion;
-) Newly Installed Valves Monitoring Completion;
-) Repair Verification Monitoring;
-) DTM Unit Percentage and Justification; *and*
-) Technician Monitoring Pace Review.

In addition to the database assessment, the following checks were conducted by the on-site audit team:

-) Current calibration gas cylinder certification records;
-) Daily Calibration records from July 2015 to May 2016;
-) The LDAR Plan;
-) The most recent analyzer performance checks;
-) The most recent LDAR technician training records;
-) Weekly pump visual inspections for all LDAR pumps;
-) Field verification of twenty-five (25) DTM components;
-) Field review of all DOR components;
-) Monitoring records for Closed Vent System (CVS);

-) Monitoring records for twenty-eight (28) field-selected valves; *and*
-) The facility's LDAR-highlighted P&IDs for all Covered Units.

Electronic data capture of the daily monitoring results was verified during the monitoring observation and overall data management was reviewed by exercising the database with requests for special reports.

SECTION 3

AUDIT METHODOLOGY

This audit included two primary elements: a compliance review and comparative monitoring. A description of the methodology used by Sage for each of these elements follows.

3.1 Compliance Audit

Sage performed a check of the LDAR program against the requirements of applicable regulations. For Merit the applicable regulations are:

-) 40 CFR 60 Subpart GGG and VV;
-) 40 CFR 60 Subpart KKK;
-) 40 CFR 60 Subpart GGGa and VVa; *and*
-) U.S. EPA Consent Decree requirements.

Detailed data reviews were performed for all units with LDAR components. Independent database queries of the LDAR data base were performed to check for compliance with requirements related to monitoring completion, repair deadlines, first attempts at repair, monitoring after repair, as well as checks of monitoring pace and for data anomalies.

Interviews were conducted with key staff involved in the LDAR program. At the Merit facility, these interviews included the LDAR Coordinator, the LDAR Contractor Area Supervisor, and the monitoring technician.

The field audit included observation of calibration and monitoring. Instrument calibration procedures were evaluated by observing the monitoring technician as he calibrated and prepared the analyzer for use prior to monitoring. The technician was also observed while monitoring an assortment of selected valves and a pump. In conjunction with the comparative monitoring, the field audit also included an evaluation of component identification and field condition issues. Untagged components encountered during the monitoring were checked for possible LDAR applicability. The investigation of field condition issues also included open-ended line control and sample station flushing control.

3.2 Comparative Monitoring

The Sage audit team made independent Method 21 measurements on components from all of the ELP Covered Units at the Merit Kalkaska facility. Various valves and pumps were selected for monitoring. The auditor started monitoring at one end of the unit by performing a Method 21 inspection of the closest component type. The auditor then proceeded in an orderly manner through the entire process unit selecting a fraction of the component types in accordance with their target percentage, (for example, monitor one valve and skip three valves for a 25% valves monitoring target). The comparative monitoring was completed only on normally accessible components. No difficult-to-monitor or unsafe-to-monitor components were tested, although a

representative sample of elevated components that could be monitored from fixed platforms reachable by stairs or ladders was inspected.

The audit team used their own TVA 1000B™ analyzers. Calibration of the audit analyzers was performed with the site's certified 2% accurate calibration gases with concentrations of 0, 500, 2,000, and 10,000 ppmv methane-in-air. Drift checks of the audit TVAs were performed using the 500 ppmv standard both mid-day and at end-of-day. Monitored component counts were kept with mechanical counters.

Table 3-1 defines the leak definitions in effect at the Merit Kalkaska facility at the time of the audit. The following information was recorded by the auditors in a field notebook for each component found leaking above its leak definition: tag number, concentration reading, component description and timestamp information. All other field notes were similarly recorded. At the end of each day, all field data was transferred to electronic spreadsheets for processing. Analyzer calibration and drift check results were handled in the same manner. All of the leaks found during the comparative monitoring were confirmed by a site technician and were entered into the site database and tagged for repair or if valves, for replacement or repair with Low-Low-E technology.

Table 3-1
Component Leak Definitions

Component Type	Leak Definition
Valves	≥ 500 ppm
Pumps	≥ 2000 ppm

SECTION 4

AUDIT RESULTS

This section discusses compliance issues, the comparative monitoring results, and program strengths.

4.1 Compliance Issues

LDAR regulations include many detailed requirements for work practices and recordkeeping. This in-depth audit (10 labor days of field investigation plus 2 labor days of database review) did not identify any compliance issues.

4.2 Comparative Monitoring

Comparative monitoring was performed on valves and pumps in all Covered Units to evaluate the site's reported leak rates. Section 4.2.1 describes the Consent Decree's comparative monitoring requirements. Section 4.2.2 provides the Comparative Monitoring results, and Section 4.2.3 discusses their statistical significance.

4.2.1 Consent Decree Requirements for Comparative Monitoring and Leak Ratio Calculations

Merit's CD requires that Comparative Monitoring be conducted at all Covered Process Units during the audit. The CD further requires that a historical, Average leak percentage from prior periodic monitoring events, broken down by equipment type (i.e. valves and pumps), be calculated for comparison with the audit's Comparative Monitoring results. The historical period as specified in the Consent Decree, varies by component type. For valves, the historical period includes the most recent four (4) quarters of monitoring results (3rd Quarter 2015 – 2nd Quarter 2016). For pumps, the historical period is the most recent twelve (12) monitoring months (July 2015 – June 2016). The site's historical, average leak percentage for both valves and pumps was calculated as the ratio of the number of leaking components to the number of components monitored within that component type's historical period. The Comparative Monitoring Audit Leak Percentage for each component type was calculated in a similar manner: the number of leaks found by the auditors divided by the number of components they monitored.

Comparative Monitoring Leak Ratios were calculated for each equipment type as the Comparative Monitoring leak percentages divided by the site's historic average leak percentages. As per Paragraph 46 of the Consent Decree, if a Comparative Monitoring Leak Ratio is 3.0 or higher and the Comparative Monitoring Audit Leak Percentage is greater than or equal to 0.5 percent, then a monitoring Corrective Action Plan will be required.

4.2.2 Comparative Monitoring Results

As indicated in Tables 4-1 and 4-2, the Comparative Monitoring leak rate results support the site's historical, average leak rates for valves and pumps. The site's historical average leak rate for valves is 1.58% -- slightly higher than the audit's Comparative Monitoring valve leak rate of

1.1%. The Merit facility has an average historical leak rate of 0.0% for pumps, and this also was validated by the Comparative Monitoring as shown in Table 4-2. As indicated in both tables, the resulting Leak Ratios were well below the CD's 3.0 Corrective Action threshold.

Table 4-1
Comparative Monitoring Leak Ratio For Valves

UNIT	SITE VALVE LEAK RATES (Based on the last 4 monitoring periods)			AUDIT VALVE LEAK RATES			COMPARATIVE MONITORING VALVE LEAK RATIO (Calculated as Audit Leak %/Site Leak %)
	# Valves Monitored	# Valve Leaks	Site Valve Leak %	# Valves Monitored	# Valve Leaks	Audit Valve Leak %	
ALL	13,625	215	1.58%	1,142	12	1.05%	0.66

Table 4-2
Comparative Monitoring Leak Ratio For Pumps

UNIT	SITE PUMP LEAK RATES (Based on the last 12 monitoring periods)			AUDIT PUMP LEAK RATES			COMPARATIVE MONITORING PUMP LEAK RATIO (Calculated as Audit Leak %/Site Leak %)
	# Pumps Monitored	# Pump Leaks	Site Pump Leak %	# Pumps Monitored	# Pump Leaks	Audit Pump Leak %	
ALL	204	0	0.00%	18	0	0.00%	0.00

4.2.3 Statistical Analyses of the Comparative Monitoring Results

Two statistical tests were used to evaluate the results of the comparative monitoring:

-) 95% Confidence Intervals; and
-) Chi Square Test.

The 95% Confidence Intervals (CIs) were calculated around the overall audit leak rates for valves and compared with the site's average historical leak rate ranges for valves. The degree of overlap between the two was used as an indicator of agreement. It was not possible to do the same with the pumps since both the site and the audit reported 0.0% leak rates.

The Chi Square statistic is a non-parametric test, which indicates the probability that both leak rate results are describing the same population. It should be noted that Chi Square does not assume that the audit leak rates are correct; it simply measures the degree of similarity between the site's historical leak rate data and the audit's leak rate data.

The statistical results of the comparative monitoring, presented both in Table 4-3 and in Figure 4-1, can be summarized as follows:

-) **Valves:** Excellent Result – the audit's Comparative Monitoring leak rate (1.1%) is slightly below the site's average historical leak rate (1.3%). The site's average historical leak rate falls within the audit's confidence interval while its upper range extends beyond. A Chi Square result of 20% sufficiently validates both leak rate results.
-) **Pumps:** Excellent Result – No pump leaks (0.0%) were detected during the Comparative Monitoring and no pump leaks (0.0%) were detected by the site over the twelve (12) month audit period. Since the number of pumps monitored by the auditors equaled the pump population the Chi Squared test result is 100%.

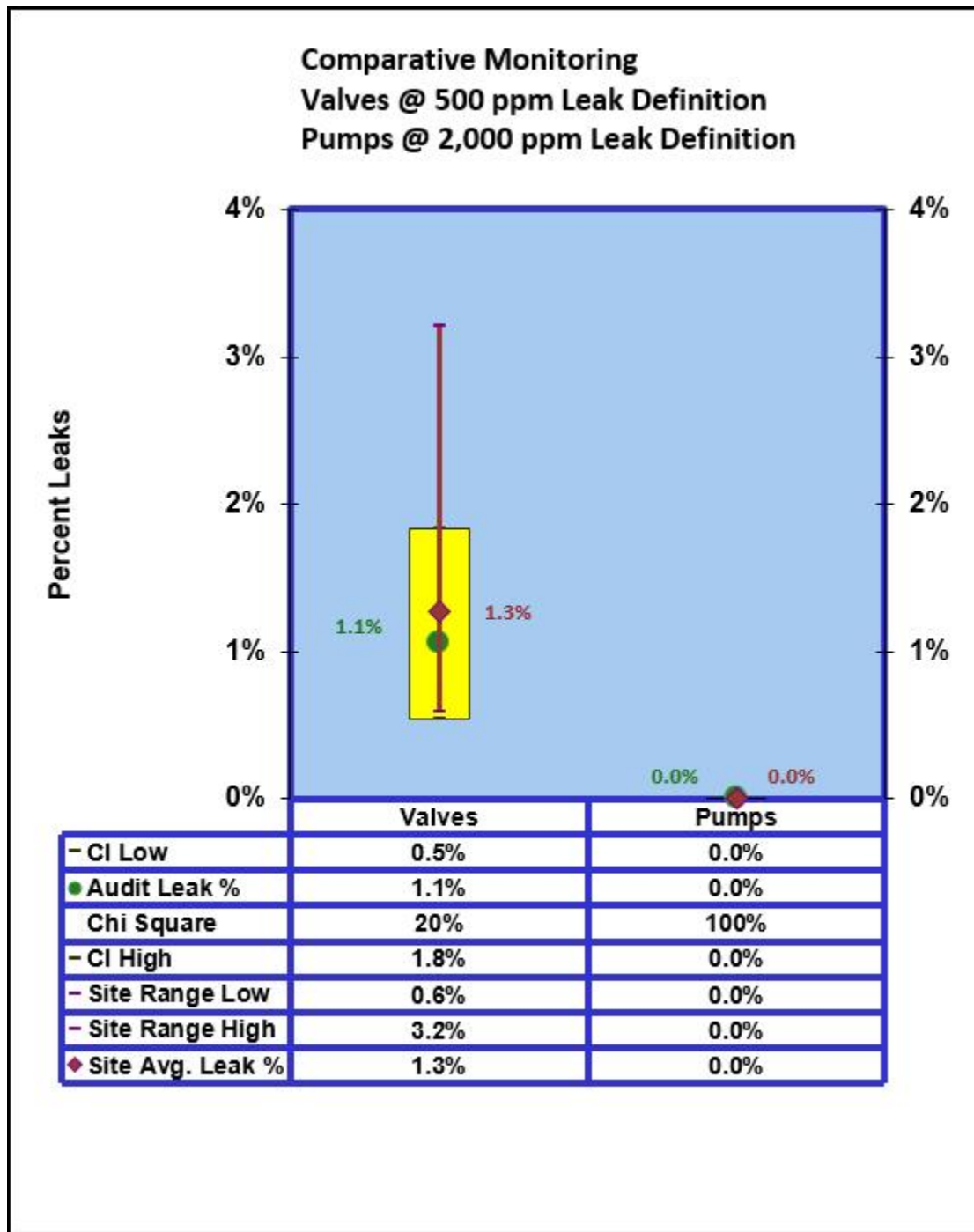
Table 4-3. Comparative Monitoring Results

Site Average Historical Leak Rate Data ¹				Audit Leak Rate Data				
Component Type	Avg. Leak Rate	Leak Range	Count	# Monitored	# Leaks	Leak Rate	95% Confidence Intervals	Prob. ²
Valves	1.3%	0.6%-3.2%	3,355	1,142	12	1.1%	0.5%-1.8%	20%
Pumps	0.0%	0.0%	17	17	0	0.0%	Not Applicable	100%

¹Site leak rates calculated as the average of 4 quarters (3Q15-2Q16) for valves and as the average of 12 months (Jul-15 – Jun-16) for pumps.

²Percent probability that both leak rate results are describing the same population as determined by the Chi Square Test.

Figure 4-1. Comparative Monitoring Results



4.3 Program Strengths

Recognition of program strengths is important to provide a balanced audit perspective. The LDAR program at the Merit Kalkaska facility has many important strengths. Table 4-4 identifies two program strengths especially noted during this audit.

Table 4-4
Program Strengths

Item	Description
1	<u>CVS Monitoring</u> -- Hard-piped CVS components are required to be visually inspected for leaks once per year. The Merit Kalkaska facility conducts quarterly Method 21 monitoring of its CVS components.
2	<u>LDAR P&ID Markups</u> -- The highlighted P&IDs indicating LDAR applicable lines for the ELP units are well done. A color legend is provided at the front of the drawing package and LDAR applicable process lines are clearly and neatly identified. No overlooked process lines were identified during the P&ID review.

SECTION 5

GLOSSARY OF ABBREVIATIONS

GLOSSARY OF ABBREVIATIONS	
CD	Consent Decree
CFR	Code of Federal Regulations
CVS	Closed Vent System
DOR	Delay of Repair
DTM	Difficult-to-Monitor
ELP	Enhanced LDAR Program
EPA	U.S. Environmental Protection Agency
LDAR	Leak Detection and Repair
LP	Limited Partnership
Low-E	Low Emission
Merit	Merit Energy Company
MI	Michigan State
MOC	Management of Change
NDE	No Detectable Emissions
NTM	Normal to Monitor
OAC	Ohio Administrative Code
OEL	Open-ended Line
P&ID	Piping and Instrumentation Diagram
ppmv	Concentration measurement in parts per million by volume
QA/QC	Quality Assurance/Quality Control
Sage	Sage ATC Environmental Consulting, LP
TVA 1000B	Thermo Environmental Toxic Vapor Analyzer
UTM	Unsafe-to-Monitor